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(6) INVESTIGATE THE PROPERTIES OF GLASSES TRANSMITTING IN THE 3 TO 5 AND 8 TO 14 MICRON WINDOWS.

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Contract No.: Nonr 4212(00)

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Project Engr.: J. Jerger, Jr.
Hicksville, N. Y.
WE 8-9700, Ext. 327

Title of Work: Investigate the Properties of Glasses Transmitting in the 3 to 5 and 8 to 14 Micron Windows

1. INTRODUCTION

1.1 Work during this period has continued on the selection and properties measurements of 20 As-S-Se-Te glasses.

1.2 Investigation of the 12.8 micron absorption band has included melting of 2 kg quantities of representative As-Se-Te glasses to verify oxide elimination procedures. This investigation has also been extended into the area of As-Se-Ge glasses.

1.3 Work was also begun on certain aspects of the investigation of the long wavelength absorption characteristics of As-Se-Te glasses.

2. MAJOR ACCOMPLISHMENTS

2.1 Part I - Selection and Properties Measurement of As-S-Se-Te Glasses.

Twenty glasses have been selected for complete property measurement. The softening range of these materials lies between 100 and 180°C, and their transmission properties are roughly equivalent to that of As_2S_3 glass. From first-order measurements made on the rapid refractometer, the indices will be in the range from 2.2 to 3.0.

Specimens are being prepared for measurement of chemical, optical, physical and thermal properties.

2.2 Part II - Investigation of Infrared Absorption as a Function of Formulation Procedures

Dr. Howard A. Robinson, Head of Physics Dept. Adelphi University has been retained as a consultant on this part of the program. Dr. Robinson's fifteen years of study of the vitreous state is expected to enable him to make a significant contribution to the progress of the present investigation.

Equipment for subjecting glass specimens to simultaneous high temperature and pressure has been ordered. Delivery is expected within the next two weeks, and experimentation will begin as soon as the installation has been completed.

In addition to determining effects on IR absorption, the use of high temperature and pressure is expected to provide data which will either substantiate or disprove the theory that structurally the sulfide, selenide and telluride glasses consist of molecular chains or laminae cross-linked with arsenic. This theory presupposes a threefold coordination, and density increase under pressure should be relatively small. If, instead, coordination should be fivefold, density changes may be expected to be quite pronounced. Pressure effects on density and absorption are expected to yield information on interatomic spacing.

Two-kilogram melts were made of As_2Se_3, As_2Se_5 and glasses containing 30 As, 30 Se, 40 Te and 25 As, 45 Se, 30 Te in order to verify oxide removal procedures. After melting and homogenizing, the melt tubes were raised in the furnace so that the top ends were at a temperature below 190°C while the melts were maintained at 500°C. After soaking overnight in this manner to enable the gaseous oxides to escape and condense in the cold end, the melts were slowly cooled and annealed. Reduction of the 12.8μ band indicates the efficacy of this method.

Reconsideration of the fundamental absorption bands of various oxides indicated that in glasses containing As-Se-Ge there is an overlap of the GeO_2 and As_2O_3 bands. From

this, it seemed that elimination of oxides from As-Se-Ge glasses which have high softening points should significantly improve infrared transmission. Experimental melting is now in progress to test this supposition.

In order to study "side band" effects or broadening of fundamental absorption bands caused by the amorphous structure of these glasses, specimens of As_2S_3, As_2Se_3 and As_2Se_5 are being carefully formulated in order to maintain the highest possible purity and homogeneity. The application of Beers Law will determine exactly where in the spectrum the fundamental absorption and side bands, if any, exist. Efforts are also being made to obtain single crystals of these compounds of sufficient size and purity to enable a comparison between the absorption characteristics of the vitreous and crystalline forms.

3. PROBEMS ENCOUNTERED

No particular problems were encountered during this period.

4. FUTURE PLANS

4.1 Part I

Property determination of the selected glasses will proceed.

4.2 Part II

Work will continue on the study of the 12.8μ absorption band and on the fundamental bands of As, S and Se compounds.

High temperature-pressure equipment will be installed and investigation of effects of variation of these parameters on the glasses will begin.